

SHEET CONVEYING APPARATUS, SHEET POST-PROCESSING APPARATUS, AND IMAGE FORMING APPARATUS PROVIDED WITH SHEET CONVEYING APPARATUS AND IMAGE FORMING APPARATUS

5 BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a sheet conveying apparatus, a sheet post-processing apparatus which performs processing to a sheet, and 10 an image forming apparatus which is provided with the sheet conveying apparatus and the sheet post-processing apparatus and conveys the sheet by the sheet conveying apparatus or forms an image in the sheet and performs the processing to the sheet by the 15 sheet post-processing apparatus, particularly relates to the sheet conveying apparatus which is formed so as to narrow a space in upward and downward directions which a sheet path occupies, the sheet post-processing apparatus, and the image forming apparatus which is provided with the sheet conveying apparatus and the sheet post-processing apparatus. 20

Related Background Art

In the related art, for example, the sheet post-processing apparatus performs alignment, which 25 arrange an end portion of the sheet received from a main body of the image forming apparatus at an intermediate stacking portion, and post-processing at

a sheet post-processing portion in which the sheet is bound by, e.g. a stapler and discharges the sheet to stack it. The sheet post-processing portion which is sheet post-processing means, the intermediate roller, 5 a sheet discharging roller, and the like are provided in the intermediate stacking portion. The sheet post-processing portion is placed on the upstream side in a sheet conveying direction higher than the nip of the intermediate roller.

10 Therefore, in a sheet post-processing mode, the sheet post-processing apparatus in the related art once switchback-conveys the sheet passed through the intermediate roller to the upstream side in a sheet conveying direction, strikes the sheet against a 15 reference wall, and aligns a rear end of the sheet. Then, the sheet post-processing apparatus performs the post-processing to the sheet at that position with the sheet post-processing portion and finally discharges the sheet to a stacking tray with the 20 sheet discharging roller to stack the sheet.

However, in the sheet post-processing apparatus in the related art, since the sheet post-processing portion is provided on the upstream side higher than the intermediate roller, the sheet passed through the 25 intermediate roller is once switchback-conveyed to the upstream side, which results in double provision in a vertical direction of a first sheet path from an

entrance of the sheet post-processing apparatus to the intermediate roller and a second sheet path from the reference wall to the sheet discharging roller. Therefore, in the sheet post-processing apparatus, a 5 height of the main body is increased and a size tends to be enlarged.

SUMMARY OF THE INVENTION

It is an object of the invention to provide the 10 sheet post-processing apparatus in which a space in upward and downward directions, which the sheet path occupies, is narrowed.

It is an object of the invention to provide the image forming apparatus having the sheet post- 15 processing apparatus in which a space in upward and downward directions, which the sheet path occupies, is narrowed in the main body.

In order to achieve the above-described object, a sheet post-processing apparatus of the present 20 invention comprises sheet conveying means for conveying a sheet, a conveying upper guide which guides an upper surface of the sheet conveyed by the sheet conveying means and is displaceable in upward and downward directions, a conveying lower guide 25 which opposes to the conveying upper guide on a lower side and supports a lower surface of the sheet conveyed by the sheet conveying means to guide the

sheet, a sheet discharging upper rotating body and a sheet discharging lower rotating body which discharge and convey the sheet on a downstream side of the conveying upper guide and the conveying lower guide
5 and are arranged in the upward and downward directions, an arm member which has the sheet discharging upper rotating body and is displaceable in the upward and downward directions, ascending and descending means for lifting the arm member upward to
10 separate the sheet discharging upper rotating body from the sheet discharging lower rotating body, sheet post-processing means provided on the downstream side in a sheet conveying direction lower than the sheet conveying means and performs processing to the sheet
15 stacked in the conveying lower guide, and interlocking means which upward displaces the conveying upper guide when the arm member is displaced upward by the ascending and descending means, wherein the sheet post-processing means, the
20 sheet discharging upper rotating body, and the sheet discharging lower rotating body are orderly arranged on the downstream side in the sheet conveying direction lower than the sheet conveying means.

In order to achieve the above-described object,
25 a sheet post-processing apparatus of the present invention comprises sheet conveying means for conveying a sheet, a conveying upper guide which

guides an upper surface of the sheet conveyed by the sheet conveying means and is displaceable in upward and downward directions, a conveying lower guide which opposes to the conveying upper guide on a lower 5 side and supports a lower surface of the sheet conveyed by the sheet conveying means to guide the sheet, a sheet discharging upper rotating body and a sheet discharging lower rotating body which discharge and convey the sheet on a downstream side of the 10 conveying upper guide and the conveying lower guide and are arranged in the upward and downward directions, an arm member which has the sheet discharging upper rotating body and is displaceable in the upward and downward directions, ascending and 15 descending means for lifting the arm member upward to separate the sheet discharging upper rotating body from the sheet discharging lower rotating body, sheet post-processing means provided on the downstream side in a sheet conveying direction lower than the sheet 20 conveying means and performs processing to the sheet stacked in the conveying lower guide, and interlocking means for upward displacing the conveying upper guide when the arm member is displaced upward by the ascending and descending 25 means, wherein the interlocking means upward displaces the conveying upper guide after the arm member is lifted by the ascending and descending

means and the sheet discharging upper rotating body is separated from the sheet discharging lower rotating body to be displaced to a position higher than a sheet guiding surface of the conveying upper 5 guide.

In a sheet post-processing apparatus of the invention, an upward displacement distance of the sheet discharging upper rotating body which is displaced by the arm member is set longer than the 10 upward displacement distance of the conveying upper guide.

In a sheet post-processing apparatus of the invention, the interlocking means upward displaces the conveying upper guide after the arm member is 15 lifted by the ascending and descending means and the sheet discharging upper rotating body is separated from the sheet discharging lower rotating body to be displaced to a position higher than a sheet guiding surface of the conveying upper guide.

20 In a sheet post-processing apparatus of the invention, the interlocking means has a pair of abutting portions which is provided in the conveying upper guide and the arm member and which can be separated from each other, and the pair of abutting 25 portions displaces the conveying upper guide in such a manner that the pair of abutting portions abuts on each other, after the arm member is lifted by the

ascending and descending means and the sheet discharging upper rotating body is separated from the sheet discharging lower rotating body to be displaced to a position higher than a sheet guiding surface of 5 the conveying upper guide.

In a sheet post-processing apparatus of the invention, the interlocking means has an elastic body which interlocks the conveying guide with the arm member, and the arm member displaces the conveying 10 upper guide through the elastic body after the arm member is lifted by the ascending and descending means and the sheet discharging upper rotating body is separated from the sheet discharging lower rotating body to be displaced to a position higher 15 than a sheet guiding surface of the conveying upper guide.

In a sheet post-processing apparatus of the invention, an end portion on the downstream side of the conveying upper guide is located higher than a 20 peripheral surface of the sheet discharging upper rotating body when the arm member is located downward, and the end portion on the downstream side of the conveying upper roller is located lower than the peripheral surface of the sheet discharging upper rotating body when the arm member is located upward. 25

In a sheet post-processing apparatus of the invention, the sheet conveying means, the conveying

lower guide, the sheet post-processing means, the sheet discharging upper rotating body, and the sheet discharging lower rotating body are substantially arranged in line.

5 In a sheet post-processing apparatus of the invention, the ascending and descending means has a cam which displaces the arm member in the upward and downward directions in such a manner that the cam is rotated while the cam is always in contact with the
10 arm member.

 A sheet post-processing apparatus of the invention further comprises returning means for rotating the sheet stacked in the conveying lower guide to an upstream side in a sheet conveying
15 direction to return the sheet, wherein the conveying upper guide and the returning means are provided while rotating centers of the conveying upper guide and the returning means are located at the same position.

20 A sheet post-processing apparatus of the invention further comprises energizing means for energizing the conveying upper guide to a side of the conveying lower guide is provided between the conveying upper guide and the arm member.

25 In order to achieve the above-described object, a sheet post-processing apparatus comprises sheet conveying means for conveying a sheet, a conveying

upper guide which guides an upper surface of the sheet conveyed by the sheet conveying means and is displaceable in upward and downward directions, a conveying lower guide which opposes to the conveying 5 upper guide on a lower side and supports a lower surface of the sheet conveyed by the sheet conveying means to guide the sheet, a sheet discharging upper rotating body and a sheet discharging lower rotating body which discharge and convey the sheet on a 10 downstream side of the conveying upper guide and the conveying lower guide and are arranged in the upward and downward directions, ascending and descending means for separating the sheet discharging upper rotating body from the sheet discharging lower 15 rotating body, and sheet post-processing means provided on the downstream side in a sheet conveying direction lower than the sheet conveying means and performs processing to the sheet stacked in the conveying lower guide, wherein the sheet discharging 20 upper rotating body can be displaced with the conveying upper guide.

In a sheet post-processing apparatus of the invention, the conveying upper guide has an endless belt which can be rotated with the sheet discharging 25 upper rotating body.

A sheet post-processing apparatus of the invention comprises a first processing mode which

positions the arm member at a lower position and passes the sheet through the conveying lower guide with the sheet discharging upper rotating body and the sheet discharging lower rotating body to convey

5 the sheet, and a second processing mode which upward displaces the arm member and the sheet discharging upper rotating body, intermediately stacks the predetermined number of sheets in the conveying lower guide at a position where the conveyed sheet is

10 passed through the sheet conveying means, performs the post-processing to the predetermined number of sheets with the sheet post-processing means, displaces downward the arm member, and discharges a bundle of the predetermined number of sheets with the

15 sheet discharging upper rotating body and the sheet discharging lower rotating body.

In order to achieve the above-described object, an image forming apparatus of the invention comprises image forming means for forming an image in a sheet and a sheet post-processing apparatus which performs the post-processing to the sheet in which the image is formed by the image forming means, wherein the sheet post-processing apparatus is one of the above-described sheet post-processing apparatuses.

25 In a sheet post-processing apparatus of the invention, the sheet post-processing means is placed on the downstream side in the sheet conveying

direction lower than the sheet conveying means and the sheet discharging upper rotating body and the sheet discharging lower rotating body are placed on the downstream side of the sheet post-processing means, so that the sheet path from the sheet post-processing means to the sheet discharging upper rotating body and the sheet discharging lower rotating body can be substantially formed in line, the space in the upward and downward directions which the sheet pass occupies can be narrowed, and the height of the sheet post-processing apparatus itself can be lowered.

In the sheet post-processing apparatus of the invention, the sheet discharging upper rotating body can be separated from the sheet discharging lower rotating body and the arm member is interlocked (linked) with the conveying upper guide, so that the sheet post-processing apparatus can lower the sheet discharging upper rotating body and the conveying upper guide to narrow the distance between end portions on the downstream side of the conveying upper guide and the conveying lower guide, surely convey the sheet into the position between the sheet discharging upper rotating body and the sheet discharging lower rotating body, and surely discharge the sheet in the simply stacking mode.

In the sheet post-processing mode, the sheet

post-processing apparatus of the invention previously retracts upward the sheet discharging upper rotating body higher than the sheet guiding surface of the conveying upper guide so that the leading end

5 (downstream end) of the sheet does not collide with the peripheral surface of the retracted sheet discharging upper rotating body, and then the sheet post-processing apparatus interlocks (links) the arm member with the conveying upper guide and separates

10 the conveying upper guide from the conveying lower guide, so that the distance in the direction of the sheet thickness can be widely secured while the space in the upward and downward directions which the sheet path occupies is set narrower than ever, and the

15 alignment of the bundle of the sheets can be surely secured.

In a sheet post-processing apparatus of the invention, the central position of the rotation of the conveying upper guide, the arm member, and the

20 sheet discharging upper rotating body are aligned at the same position and the conveying upper guide and the arm member are displaced by the same descending and ascending means, so that the minimum number of constituent components, low cost, and space savings

25 can be realized.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematically sectional view showing the whole of a configuration of an image forming apparatus such as a printer including a sheet post-processing apparatus of a first embodiment of 5 the invention;

Fig. 2 is a schematically sectional view showing the whole of the configuration of the sheet post-processing apparatus of the first embodiment of the invention;

10 Fig. 3 is a view for illustrating an operation of a sheet post-processing mode which is a second processing mode;

Fig. 4 shows a state in which bound sheets of paper are discharged in the sheet post-processing 15 apparatus of Fig. 2;

Fig. 5 shows the state which has become the sheet post-processing mode which is the second processing mode in the sheet post-processing apparatus of Fig. 2;

20 Fig. 6 shows a case in which the sheet is supported with joggers on both sides of the sheet when the state has become the sheet post-processing mode which is the second processing mode in the sheet post-processing apparatus of Fig. 2;

25 Fig. 7 shows the case in which a distance between the joggers on both sides is widened to drop the sheet when the state has become the sheet post-

processing mode which is the second processing mode in the sheet post-processing apparatus of Fig. 2;

Fig. 8 shows the case in which the distance between the joggers on both sides is widened to drop 5 the sheet on a stacking tray when the state has become the sheet post-processing mode which is the second processing mode in the sheet post-processing apparatus of Fig. 2;

Fig. 9 is an exploded view showing a peripheral 10 portion of a pair of sheet discharging rollers and a conveying upper guide of the sheet post-processing apparatus of the Fig. 2 when the sheet post-processing apparatus becomes the state of a simply stacking mode which is a first processing mode;

15 Fig. 10 shows the state in which a cam starts to rotate counterclockwise in Fig. 9;

Fig. 11 shows the state in which the cam further rotates counterclockwise in Fig. 10;

20 Fig. 12 shows the state in which the cam further rotates counterclockwise in Fig. 11;

Fig. 13 is a view for illustrating a relative positional relationship between the sheet discharging upper roller and a conveying upper guide when a sheet discharging upper roller ascends and conveyance of 25 the sheet is not smoothly performed;

Fig. 14 shows a main part of the sheet post-processing apparatus of a second embodiment;

Fig. 15 shows the state in which a conveying upper guide is pulled by a tension spring and rotated upward; and

Fig. 16 shows the main part of the sheet post-processing apparatus of a third embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The sheet post-processing apparatus of preferred embodiments of the invention and a laser beam printer (hereinafter referred to as "printer") which is the image forming apparatus including the sheet post-processing apparatus in its main body will be described below referring to the accompanying drawings.

There are printers, copying machines, facsimile machines, and multi function machines in the image forming apparatus. Since the sheet post-processing apparatus of the embodiments of the invention can be provided in the various kinds of image forming machines described above, the sheet post-processing apparatus is provided not only in the printer but in other various kinds of image forming apparatus.

(PRINTER)

Fig. 1 is the schematically sectional view showing the whole of the configuration of the image forming apparatus, e.g. a printer A including a sheet post-processing apparatus B1 of a first embodiment of

the invention.

The sheet post-processing apparatus B1 is placed on an upper portion of a main body Aa as one of constituent components of the printer A.

5 In the printer A, the main body Aa is solely connected to a computer or connected to a network such as LAN. The printer A forms (prints) an image in the sheet on the basis of image information, a printing signal, or the like, which is transmitted
10 from the computer or the network, by a predetermined image forming process and discharges the sheet. The printer A may be provided with the reading portion which reads an original, duplicate the image of the original into the sheet on the basis of reading
15 information of the reading portion, and discharge the sheet.

The sheet post-processing apparatus B1 directly discharges the sheets conveyed from the main body Aa or binds the sheets by aligning width of the sheet, 20 bundles the sheets, and then staples the sheets with the stapler 11 to discharge the sheets. The discharged sheet or bundled sheets are stacked on a stacking tray 4 with the sheet facing downward.

The sheet post-processing apparatus B1 and the 25 main body Aa are electrically connected with a cable connector (not shown). A casing portion Ba storing each portion of the sheet post-processing apparatus

B1 is installed in the main body Aa described in detail later.

The configuration and action of each portion of the main body Aa will be described below along a 5 conveying path of a conveyed sheet C.

The plurality of sheets C is stacked in a sheet feeding cassette 21 of the main body Aa. The plurality of sheets C is orderly fed from the uppermost sheet with the sheet separated by various 10 rollers. In the main body Aa, e.g. an image forming portion 22 which is image forming means for forming a toner image by an image forming process of a laser beam method, the toner image is transferred onto an upper surface of the sheet C fed from the sheet 15 feeding cassette 21 by the predetermined printing signal transmitted from the computer or the network. When the sheet C is conveyed to the image forming portion 22, the toner image has been already formed on a photosensitive drum 23 in the image forming 20 portion 22 by the toner in a cartridge 24.

Then, heat and pressure are applied to the sheet C by a fixing apparatus 25 on the downstream side, and the toner image is fixed. The sheet C in which the image is fixed is selected whether the 25 sheet C is discharged to a face down (FD) discharging portion 27 provided on an upper portion of the main body Aa or to the stacking tray 4 of the sheet post-

processing apparatus B1, depending on a position of a flapper 26 of the main body Aa, which is switched on the basis of a control signal from a control portion (not shown).

5 When the flapper 26 is switched to the position shown by a broken line, the sheet C is guided by the flapper 26 to be returned at an almost U-shaped sheet conveying path to a pair of discharging rollers 28, the image face of the sheet C is reversed, and the 10 sheet C is discharged from the main body Aa to the FD discharging portion 27 by the pair of discharging rollers 28 with the image surface faced downward.

When the staple processing is performed in the stapler 11 on the basis of a command previously 15 output from the computer or the like, before the sheet C to be stapled is conveyed to sheet post-processing apparatus B1, the printer A conveys the sheet C to the sheet post-processing apparatus B1 in such a manner that the flapper 26 is rotated 20 counterclockwise from the position of the broken line by a solenoid (not shown) and abuts on a stopper 29 to stop on the position of a solid line.

Accordingly, the sheet C is conveyed to an entrance of the sheet post-processing apparatus B1 by 25 the guidance of the flapper 26. The sheet C conveyed to the sheet post-processing apparatus B1 is detected with an entrance sensor 30. Then, the sheet C is

conveyed upward with a pair of entrance rollers 1.

(SHEET POST-PROCESSING APPARATUS OF FIRST EMBODIMENT)

Fig. 2 is the schematically sectional view showing the whole of the configuration of the sheet 5 post-processing apparatus B1.

The pair of entrance rollers 1 receives the sheet C conveyed from the main body Aa and conveys it to an intermediate roller 2 which is sheet conveying means. The intermediate roller 2 conveys the 10 received sheet C to a pair of sheet discharging rollers 3. The pair of sheet discharging rollers 3 discharges the sheet C to the stacking tray 4.

A jogger 5 aligns edge portions of the sheets (aligns the width of the sheet) along the sheet 15 conveying direction. A puddle 6 aligns a rear end of the sheet in such a manner that the sheet abuts on a reference wall 10. The abutting reference wall 10 for alignment in the conveying direction is almost vertically formed in the vicinity of the intermediate 20 roller 2 described later and on the downstream side of the intermediate roller 2 while the reference wall 10 is directed from a conveying lower guide 9b, described later, toward the intermediate roller 2.

An intermediate stacking portion D includes the 25 intermediate roller 2, the puddle 6, the stapler 11 described later, and the like. An alignment portion E includes the jogger 5.

Fig. 2 is the view for illustrating action of a simply stacking mode which is a first processing mode. A sheet discharging upper roller 3a of the pair of sheet discharging rollers 3 descends relative to a sheet discharging lower roller 3b. In this state, the single sheet C received from the image forming apparatus A is directly discharged by the pair of sheet discharging rollers 3 to be stacked in the stacking tray 4 through the pair of entrance rollers 1 and the intermediate rollers 2 without stopping at the intermediate stacking portion D. The sheet discharging roller 3 is one example of the sheet discharging means. The sheet discharging upper roller 3a is one example of a sheet discharging upper rotating body. The sheet discharging lower roller 3b is one example of a sheet discharging lower rotating body.

Fig. 3 is the view for illustrating a sheet post-processing mode which is a second processing mode. The sheet discharging upper roller 3a in the pair of sheet discharging rollers 3 is separated from the sheet discharging lower roller 3b. In this state, the single sheet C received from the image forming apparatus A is guided to the jogger 5 through the pair of entrance rollers 1 and the intermediate rollers 2. After a rear end of the sheet C is passed through the intermediate roller 2, the sheet C is

returned in the reverse direction of the sheet conveying direction by, e.g. the puddle 6 which is returning means rotated clockwise from the position of the solid line to the position of the broken line,
5 the sheet abuts on the reference wall 10, and the rear end of the sheet is aligned.

When the upstream side of the conveying lower guide 9b is lower than the downstream side of the conveying lower guide 9b, sometimes the sheet can
10 slide down toward the upstream side on the sheet discharging lower roller 3a by its deadweight and abut on the reference wall 10. Therefore, the puddle 6 is not always required. However, the rear end of the sheet can be surely aligned when the printer A is
15 provided with the puddle 6, compared with the printer A which is not provided with the puddle 6.

The sheet C is aligned in the width direction by the jogger 5 movable in a forward-backward direction in Fig. 1 and positioned at the
20 predetermined position. Even for the subsequent sheets, the sheet post-processing apparatus B1 performs the same alignment action in the intermediate stacking portion D. After the sheet post-processing apparatus B1 completes the alignment
25 of the desired number of sheets, the rear ends of the sheets are bound by sheet post-processing means, e.g. the stapler 11 provided in the vicinity of the

intermediate roller 2 and on the down stream side of the sheet conveying direction.

As shown in Fig. 4, a bundle of the bound sheets F is put between the sheet discharging upper roller 3a and the sheet discharging lower roller 3b by the second descent of the sheet discharging upper roller 3a and discharged to the stacking tray 4 by the rotation of the sheet discharging rollers 3 to be stacked.

10 The action of the jogger 5 and the discharging action of the sheet will be described below referring to the perspective view of the sheet post-processing apparatus in Figs. 5 to 8.

15 The sheet post-processing apparatus B1 shown in Fig. 5 is in the state which can correspond to the sheet post-processing mode, which is the above-described second processing mode. One jogger 5L of the joggers 5 is on standby for the other jogger 5R while the jogger 5L is opened at a sheet receiving 20 distance G. The discharged sheet from the main body Aa of the sheet post-processing apparatus B1 enters the jogger 5, and as shown in Fig. 6 after the sheet alignment and the post-processing are performed to the sheet, the sheet is discharged with the sheet 25 bound while the sheet is supported by the joggers 5R and 5L.

As shown in Figs. 7 and 8, a sheet Ca is

dropped onto the stacking tray 4 to be stacked when the joggers 5L and 5R is widened to a distance H broader than the width of the sheet (in the direction intersecting with the sheet conveying direction at 5 right angles).

Mechanisms of the pair of sheet discharging rollers 3 and a conveying upper guide 9a will be described below.

Fig. 9 is the exploded view showing the 10 peripheral portion of the pair of sheet discharging rollers 3 and the conveying upper guide 9a of the sheet post-processing apparatus B1 when the sheet post-processing apparatus B1 is in the state of the first processing mode.

15 As described above, in the simply stacking mode, the sheet conveyed from the main body Aa of the printer A to the intermediate stacking portion D is passed through the intermediate portion D and discharged to the stacking tray 4.

20 An axis of the sheet discharging upper roller 3a is rotatably supported on arm members, e.g. bearing portions 8c of an arm 8. The axis of the arm 8 is rotatably supported on a fulcrum shaft 12 provided in the casing portion Ba. The conveying 25 upper guide 9a is formed so as to guide the upper surface of the sheet, and is upward and downward rotatably supported on the same fulcrum shaft 12 for

the arm 8. The conveying lower guide 9b supports and guides the lower surface of the sheet. The conveying upper guide 9a and the conveying lower guide 9b constitute a part of the intermediate stacking portion D. The conveying upper guide 9a and the conveying lower guide 9b are one example of guiding means.

As shown in Fig. 9, the conveying upper guide 9a stops at a home position of Fig. 9 in such a manner that stopper pin 9a-1 provided in the conveying upper guide 9a abuts on a stopper 13 on the side of the casing portion Ba. A link lever 9a-2 is projected toward the upper side of the conveying upper guide 9a. The link lever 9a-2 is separated from a link portion 8a provided in the arm 8 at the state shown in Fig. 9. Accordingly, the arm 8 and the conveying upper guide 9a are not in an interlocking state. The link lever 9a-2 and the link portion 8a are one example of interlocking means, and also one example of the abutting portion.

Ascending and descending means, e.g. a cam 7 always abuts on a lower surface 8b of the arm 8. The cam 7 shown in Fig. 9 lowers and stops the arm 8 and the sheet discharging upper roller 3a whose axis is supported on the arm 8 at the lowermost position.

The sheet discharging upper roller 3a and the sheet discharging lower roller 3b mutually enter the

position between rollers, put the sheet between the rollers in the shape of a wave and rotate toward the sheet conveying direction. At this point, a peripheral surface 3aa of the sheet discharging upper 5 roller 3a is projected downward from a sheet guiding surface 9aa of the lower surface of the conveying upper guide 9a.

Accordingly, the sheet rushes into the peripheral surface of the pair of sheet discharging 10 rollers 3, and the sheet is formed in the shape of the wave by the sheet discharging upper roller 3a and the sheet discharging lower roller 3b and nip- conveyed to be directly simply discharged to the stacking tray 4. The plurality of sheet discharging 15 upper rollers 3a and sheet discharging lower rollers 3b are alternately arranged in the direction of the rotating axis. However, the plurality of sheet discharging upper rollers 3a and sheet discharging lower rollers 3b are arranged at the position where 20 the sheet discharging upper roller 3a and the sheet discharging lower roller 3b are in contact with each other without alternately arranging the plurality of sheet discharging upper rollers 3a and the sheet discharging lower rollers 3b, and the sheet may be 25 conveyed at the flat state to be discharged without forming the sheet in the shape of the wave.

Figs. 10 to 12 are the view for illustrating

the action of the arm 8 and the conveying upper guide 9a when the cam 7 rotates counterclockwise in figures. Fig. 10 shows the state in which the cam 7 starts to rotate counterclockwise. A descending distance of 5 the sheet discharging upper roller 3a moved upward by the arm 8 is set longer than an upward rotating distance of the conveying upper guide 9a.

By the rotation of the cam 7, the lower surface 8b of the arm 8 is pressed upward to start to rotate 10 upward about the fulcrum shaft 12. At this point, the sheet discharging upper roller 3a whose axis is supported on the arm 8 also integrally moves upward and starts to separate from the sheet discharging lower roller 3b. However, the conveying upper guide 15 9a whose axis is supported on the same fulcrum shaft 12 for the arm 8 does not become the state in which the conveying upper guide 9a is interlocked with the arm 8 (the conveying upper guide 9a does not become the state in which the conveying upper guide 9a 20 starts the link), because there is still a space between the link portion 8a of the arm and the link lever 9a-2. Therefore, only the arm 8 and the sheet discharging upper roller 3a continues the upward movement in which the arm 8 and the sheet discharging 25 upper roller 3a separate from the sheet discharging lower roller 3b. At this stage, the peripheral surface 3aa of the sheet discharging upper roller 3a

is projected downward from the sheet guiding surface 9aa of the conveying upper guide 9a.

Fig. 11 shows the state in which the cam 7 further rotates counterclockwise in the figure. By 5 the rotation of the cam 7, the link portion 8a of the arm 8 comes into contact with the link lever 9a-2 of the conveying upper guide 9a and then the conveying upper guide 9a also rotates upward with the upward rotation of the arm 8. That is to say, the arm 8 and 10 the conveying upper guide 9a become the link state.

At this stage, the peripheral surface 3aa of the sheet discharging upper roller 3a is retracted upward by a distance α_1 from the sheet guiding surface 9aa of the conveying upper guide 9a. Then, while the 15 sheet discharging upper roller 3a and the conveying upper guide 9a are held at this positional relationship (at the linked state), the sheet discharging upper roller 3a and the conveying upper guide 9a rotate upward. The sheet discharging upper roller 3a separates from the sheet discharging lower roller 3b, and the conveying upper guide 9a separates 20 from the conveying lower guide 9b.

Fig. 12 shows the state in which the cam 7 further rotates counterclockwise in the figure. The 25 arm 8 and the sheet discharging upper roller 3a finish the rotation at the state shown in Fig. 12. Even in this case, the peripheral surface 3aa of the

sheet discharging upper roller 3a is retracted upward by a distance α_1 from the sheet guiding surface 9aa of the conveying upper guide 9a. Thus, the sheet post-processing apparatus B1 receives the sheet from

5 the image forming apparatus while the sheet discharging upper roller 3a is farthest from the sheet discharging lower roller 3b and the conveying upper guide 9a is farthest from the conveying lower guide 9b.

10 As described above, in the sheet post-processing apparatus B1 of the embodiment, when the sheet discharging upper roller 3a ascends and completely separates from the sheet discharging lower roller 3b, the interlocking mechanism (linking

15 configuration) between the arm and the conveying upper guide 9a, which is the reverse state of the positional relationship between the peripheral surface 3aa of the sheet discharging upper roller 3a and the sheet guiding surface 9aa of the conveying

20 upper guide 9a, was described.

In the sheet post-processing mode, the conveyed sheet C is passed through the intermediate roller 2 and stacked on the conveying lower guide 9b, which is the intermediate stacking portion D. The puddle 6

25 rotates clockwise from the position shown by a reference numeral 6a to the position shown by a reference numeral 6b as shown in Fig. 12, comes into

contact with the sheet at position shown by the reference numeral 6b, and move the sheet to the upstream side of the conveying direction. The puddle 6 performs the longitudinal alignment of the sheet 5 while the rear end of the sheet abuts on the reference wall 10. Then, the puddle 6 continues the clockwise rotation and returns to the home position 6a. After the rear end of the sheet abuts on the reference wall 10, the lateral alignment of the sheet 10 is performed by the jogger 5.

In the sheet post-processing apparatus B1, after the above-described actions are repeatedly performed and the alignment of the predetermined number of sheets is performed, the predetermined 15 number of sheets is bound with the stapler 11 to make a bundle of sheets.

Then, the cam 7 continues the counterclockwise rotation, rotates from the position shown in Fig. 12 to the initial position shown in Fig. 9, and the 20 lowers the arm 8 and the sheet discharging upper roller 3a. Accordingly, the conveying upper guide 9a also rotates downward and stops at the position where the conveying upper guide 9a does not move downward lower than the peripheral surface 3aa of the sheet 25 discharging upper roller 3a. The pair of sheet discharging rollers 3 discharges the bundle of the sheets to the stacking tray 4 to stack it.

When the rear end of the bundle of the sheets is passed through the pair of sheet discharging rollers 3, since the initial sheet of the next bundle of the sheets is conveyed into the intermediate 5 stacking portion D by the intermediate roller 2, the cam 7 rotates counterclockwise in the figure again, and the peripheral surface 3aa of the sheet discharging upper roller 3a is retracted upward from the sheet guiding surface 9aa of the conveying upper 10 guide 9a while the arm 8, the sheet discharging upper roller 3a, and the conveying upper guide 9a move upward.

The start of the rotation of the cam 7 may be immediately after the rear end of the bundle of the 15 sheets is passed through the pair of sheet discharging rollers 3 and the initial sheet of the next bundle of the sheets enters the jogger 5 from the intermediate stacking portion D by the pair of sheet discharging rollers 3. The reason why only the 20 initial sheet is conveyed by the pair of sheet discharging rollers 3 is that the bundle of the sheets surely gets over a gap between the intermediate stacking portion D and the jogger 5 by the pair of sheet discharging rollers 3. In 25 conveying the sheet after the initial sheet, though the sheet discharging upper roller 3a completely separates from the sheet discharging lower roller 3b,

the gap does not become an obstacle to the conveying of the sheet because the initial sheets acts as a bridge to the next sheet.

Fig. 13 is the view for illustrating the relative positional relationship between the sheet discharging upper roller 3a and the conveying upper guide 9a when the sheet discharging upper roller 3a ascends and the conveying of the sheet is not smoothly performed.

Fig. 13 shows the state in which the sheet discharging upper roller 3a has completed the separation from the sheet discharging lower roller 3b while the peripheral surface 3aa of the sheet discharging upper roller 3a is projected downward by a distance α_2 from the sheet guiding surface 9aa of the conveying upper guide 9a. In the sheet C conveyed into this state, a leading end C-1 hooks on the peripheral surface 3aa of the sheet discharging upper roller 3a and moves jerkily, there is a fear of a paper jam between the conveying upper guide 9a and the conveying lower guide 9b. However, in the sheet post-processing apparatus B1 of the embodiment, as described above, since the sheet guiding surface 9aa of the conveying upper guide 9a is located at the position lower than the peripheral surface 3aa of the sheet discharging upper roller 3a, the sheet is never jammed between the conveying upper guide 9a and the

conveying lower guide 9b.

As described above, in the sheet post-processing apparatus B1 of the embodiment, since the stapler 11 is placed on the downstream side more than the nip of the intermediate roller 2 and the pair of sheet discharging rollers 3 is placed on the downstream side of the stapler 11, the intermediate stacking portion D which is formed with a sheet path 14 from the intermediate roller 2 to the pair of sheet discharging rollers 3 can be made almost a line-shaped straight path and the space in the upward and downward directions can be narrowed. That is to say, compared with the related art, the height of the apparatus itself can be lowered by narrowing the space in the upward and downward directions which the sheet path 14 occupies.

By making the sheet path 14 in form of the straight path, the simply stacking mode and the sheet post-discharging mode can be performed on the same straight path, so that the action of the sheet post-processing apparatus can be simplified.

In the simply stacking mode, the sheet post-processing apparatus B1 of the embodiment can lower the sheet discharging upper roller 3a and the conveying upper guide 9a to narrow the distance between leading ends (end portions on the downstream side) 9ab and 9bb of the conveying upper guide 9a and

the conveying lower guide 9b, surely convey the leading end of the sheet into the nip of the pair of sheet discharging rollers 3, and surely discharge the sheet.

5 In the sheet post-processing mode, the sheet post-processing apparatus B1 of the embodiment previously retracts upward the sheet discharging upper roller 3a higher than the sheet guiding surface 9aa of the conveying upper guide 9a so that the 10 leading end of the sheet does not collide with the peripheral surface 3aa of the retracted sheet discharging upper roller 3a, and then the sheet post-processing apparatus B1 link the arm 8 with the conveying upper guide 9a and separates the conveying 15 upper guide 9a from the conveying lower guide 9b, so that the space in the upward and downward directions which the sheet path 14 occupies can be set narrower than ever, a processing space having the wide distance in the direction of the sheet thickness can 20 be secured, and the alignment of the bundle of the sheets can be surely secured.

 In the sheet post-processing apparatus B1 of the embodiment, the axes of the main components (the conveying upper guide 9a, the arm 8, and the sheet 25 discharging upper roller 3a) constituting a movable portion of the sheet path in the intermediate stacking portion D are supported on the fulcrum shaft

12 which is the common central position of the rotation and the main components can be moved by the same cam 7, so that the movable portion of the intermediate stacking portion D can be realized with 5 the minimum number of constituent components, low cost, and space savings.

The height of the printer which is equipped with the sheet post-processing apparatus having the low height in the main body can be also lowered.

10 (SHEET POST-PROCESSING APPARATUS OF SECOND EMBODIMENT)

Fig. 14 shows the main part of the sheet post-processing apparatus of a second embodiment.

In the sheet post-processing apparatus B1 of 15 the first embodiment, the arm 8 is interlocked with the conveying upper guide 9a in such a manner that the link portion 8a abuts on the link lever 9a-2. However, in a sheet post-processing apparatus B2 of the second embodiment, the arm is interlocked with 20 the conveying upper guide with a tension spring 201 which is the interlocking means and an elastic body. The configurations of the sheet post-processing apparatuses of the both embodiments are different in this point and the other configurations are the same, 25 so that only different portions will be described.

In Fig. 14, the axis of the sheet discharging upper roller 3a is supported on an arm 200. In the

sheet post-processing apparatus B2, when the arm 200 is rotated upward by the rotation of a cam (not shown) having the same shape as that of the cam 7 in the sheet post-processing apparatus B1 of the first 5 embodiment and the sheet discharging upper roller 3a separates from the sheet discharging lower roller 3b, as shown in Fig. 15, a conveying upper guide 202 is pulled by the tension spring 201 and rotated upward.

When the arm 200 is rotated downward, since the 10 tension spring 201 does not upward pull the conveying upper guide 202, the interlocking state between the arm 200 and the conveying upper guide 202 is released. The arm 200 presses the conveying upper guide 202 with a compression spring 203 placed near the 15 midpoint of the arm 200 and stops at the position shown in Fig. 14. That is to say, in the conveying upper guide 202, the stopper pin 9a-1 abuts on the stopper 13 to prevent the downward rotation as shown in Fig. 9. At this point, the peripheral surface 3aa 20 of the sheet discharging upper roller 3a is projected downward from a lower surface 202aa of the conveying upper guide 202. Thus, in the sheet post-processing apparatus B2 of the second embodiment, the positional relationship between the conveying upper guide 202 25 and the peripheral surface 3aa of the sheet discharging upper roller 3a is the same as that of the sheet post-processing apparatus B1 of the first

embodiment.

In the sheet post-processing apparatus B2 of the second embodiment, in addition to the achievement of the same effect as that of the sheet post-processing apparatus B1 of the first embodiment, since the conveying upper guide 202 is pressed downward by energizing means, e.g. the compression spring 203 in the downward rotation of the arm 200, the conveying upper guide 202 is surely lowered, and the conveying upper guide 202 is not lifted by the sheet even if the sheet enters the conveying upper guide 202, the conveyance in the simply stacking mode can be improved.

(SHEET POST-PROCESSING APPARATUS OF THIRD EMBODIMENT)

A sheet post-processing apparatus B3 of a third embodiment shown in Fig. 16 has the configuration in which the carrying upper guide, e.g. a belt 300, which turns according to the sheet discharging upper rotation, e.g. the rotation of a sheet discharging upper roller 301, is used instead of the conveying upper guide 9a shown in the sheet post-processing apparatuses B1 and B2 of the first and second embodiments. In this configuration, according to the upper movement of the sheet discharging upper roller 301 by the ascending means (not shown), the belt 300 is rotated upward around the fulcrum shaft 12. Consequently, there is no projection between the belt

300 and the sheet discharging upper roller 301, so that sheet can be smoothly conveyed.

Though the belt 300 turns according to the movement of the sheet discharging upper roller 301, 5 the sheet discharging upper roller 301 may be only rotated and the belt 300 may be fixed without the rotation according to the movement of the sheet discharging upper roller 301. When the fixed belt is used, it is preferable to use the belt made of the 10 material having low friction to the sheet and good sliding properties.

In Figs. 14 and 15, a reference numeral 205 indicates a sheet detecting sensor lever for detecting the passage of the sheet which is being 15 discharged. When the sheet is conveyed, the sheet detecting sensor lever 205 is pressed by the sheet and inclined downward to detect the sheet.

In the sheet post-processing apparatus B3 of the third embodiment, in addition to the achievement 20 of the same effect as that of the sheet post-processing apparatus B1 of the first embodiment, the amount of separation and the amount of descend of the belt 300 to the conveying lower guide 9b can be set to a certain position in such a manner that the 25 distance in the upward and downward directions of the arbitrary sheet path is selected by changing the ascending position of the sheet discharging upper

roller 301 in each of the simply stacking mode and the sheet post-processing mode. Further, the distance of the sheet path can be controlled at the optimum position according to the number of bound 5 sheets and the alignment of the sheet can be further improved.

(OTHER EMBODIMENT)

The arm 8, the conveying upper guide 9a, and the belt 300 are rotated upward and downward in the 10 sheet post-processing apparatuses B1, B2, and B3 of the first to third embodiments. However, the arm 8, the conveying upper guide 9a, and the belt 300 may be moved in parallel upward and downward.

The sheet post-processing means is not limited 15 to the stapler. The sheet post-processing means may be a perforating apparatus which makes a hole in the sheet, a gluing apparatus which glues the sheets together, thread binding means which binds the sheets with the thread, or the like.

20 The sheet discharging upper rotating body and the sheet discharging lower rotating body are not limited to the roller. The sheet discharging upper rotating body and the sheet discharging lower rotating body may be also the turning endless belt.